1909MNRAS..69..223E

New Double Stars. By the Rev. T. E. Espin, M.A.

No.	B.D.	R.A. 1900.		Decl.		P.	D.	Mags.		Nights.	Date.
	°	h	m	°	′	°	″				1908.
610	+54, 3111	0	1·2	+54	27	203·4	4·20	9·4	11·2	2	·941
611	+53, 3289		1·6	53	56	292·2	10·50	8·4	10·1	2	·872
612	+54, 32		13·3	54	19	266·0	2·90	9·3	9·5	2	·988
613	+52, 79		24·0	52	50	270·6	8·25	8·3	11·8	3	·744
614	+52, 182		46·6	53	11	86·8	2·23	9·5	9·8	3	·748
615	+53, 190		53·1	53	22	267·4	3·27	9·1	11·7	2	·802
616	+53, 223	1	0·6	53	53	278·1	3·35	9·4	10·3	3	·846
	+53, 326		26·3	54	14	195·4	16·15	8·6	8·8	2	·907
	+53, 327		26·8	53	46	28·1	15·33	8·7	9·0	2	·907
617	+54, 324		29·7	54	27	304·9	3·27	9·1	9·2	2	·852
618	+53, 491	2	10·5	53	41	173·1	3·65	9·3	11·6	3	·895
619	+45, 600		15·1	45	57	243·6	5·55	8·0	10·7	2	·828
620	+53, 546		28·5	53	15	212·7	6·12	8·5	12·0	2	·916
621	+53, 601		52·5	53	56	354·1	8·25	8·4	11·5	3	·917
622	+53, 680	3	28·1	53	34	34·1	4·62	9·1	9·9	3	·915
623	+53, 705		43·7	53	15	331·2	8·02	8·5	13·9	2	·941
624	*h* 2770	15	9·8	47	14	49·6	2·30	10·0	10·1	3	·386 AB
						129·3	16·57	C=	10·5	2	·383 AC
	+49, 2363		9·5	48	57	343·0	25·75	7·0	10·2	2	·401
625	+44, 2454		17·7	44	40	252·9	1·57	9·3	10·3	2	·413
626			38·0	50	28	275·0	7·52	9·2	9·2	2	·469
627	+51, 2073	16	16·0	51	34	286·5	11·07	8·6	9·8	2	·472
628	+52, 1959		17·3	52	0	265·7	3·37	8·8	12·0	2	·472
629	+52, 1961		18·0	52	4	93·2	10·20	8·1	13·0	2	·472
630	+54, 1813		25·4	54	28	44·7	5·47	9·0	13·5	2	·517
631	+43, 2621		32·1	43	38	162·1	9·77	8·2	11·0	2	·401
632			38·2	50	25	102·9	1·75	9·3	10·0	2	·469
633	+42, 2783		58·4	42	52	258·9	6·30	7·0	11·5	2	·412
634	+42, 2789	17	0·8	42	20	98·0	1·80	9·4	10·0	2	·444
635	+52, 2075		33·0	52	14	241·7	5·77	8·9	12·0	2	·568
636			33·4	41	46	124·4	2·38	9·2	9·7	3	·517
637	+54, 1898		34·2	54	29	296·4	3·70	9·2	9·3	2	·489
638	+54, 1902		38·2	54	14	188·2	2·57	9·2	11·0	4	·530
639	+56, 2019		44·3	56	16	76·1	8·00	8·8	9·9	2	·598
640	+54, 1931		58·8	54	53	75·6	7·90	8·6	9·2	2	·552
641	+54, 1937	18	2·8	54	34	66·7	1·95	9·2	9·4	3	·602
642	+51, 2327		8·5	51	38	273·8	6·75	9·0	13·0	2	·650
643	+55, 2039		10·9	55	54	50·3	3·40	9·0	11·2	2	·565
644	+52, 2167		11·2	52	27	32·0	9·97	8·5	14·0	2	·640
645	+53, 2054		11·7	53	39	89·1	2·75	8·2	12·0	3	·560
646	+52, 2175		12·9	52	5	197·2	9·88	8·0	13·8	3	·654
647	+50, 2561		15·8	50	47	293·4	2·80	9·0	11·3	3	·776
648	+52, 2197		19·8	52	18	5·2	4·68	9·0	13·7	4	·666
649	+53, 2074		19·9	53	31	316·5	8·32	9·2	11·5	2	·624

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	°	h	m	°	′	°	″				1908.
650	+52, 2305	18	53·5	52	33	329·5	3·22	8·8	12·0	3	·752 AB
						193·6	26·79	C=	10·2	2	·721 AC
651	+51, 2476		57·8	51	58	140·1	5·87	9·2	9·5	2	·668
652	+50, 2758	19	14·0	50	41	80·0	7·05	9·2	11·2	2	·610
653	+53, 2241		23·8	53	57	284·6	11·20	9·0	9·0	2	·551
654	+54, 2152		26·0	54	34	191·5	7·60	7·2	12·5	3	·641
655	+54, 2182		32·6	54	57	57·7	2·95	10·2	11·7	5	·681 BC
						128·9	67·07	A=	9·1	3	·636 AB
656	*h* 1427		34·4	46	4	286·5	8·27	10·0	10·4	2	·841 AB
						246·2	2·75	11·2	11·5	2	·841 CD
						293·1	39·13			2	·841 AC
657	+52, 2489		39·7	53	5	113·9	2·70	9·4	11·0	2	·562
658	+52, 2521		44·0	52	53	316·3	5·18	8·6	14·0	3	·571 AB
						296·7	8·10	12·0	13·0	2	·564 CD
						90·4	31·41			3	·571 AC
659	+54, 2230		47·3	54	39	160·7	5·83	9·2	9·3	3	·744
660	+51, 2821	20	14·5	51	42	288·2	9·05	9·0	9·0	5	·602 BC
						304·1	30·41	A=	8·9	4	·568 AB
	+51, 2833		16·1	51	53	270·1	24·67	8·3	8·4	1	·572
661	+44, 3474		24·8	44	38	163·5	8·60	8·9	11·2	2	·651
662	+44, 3485		26·1	44	56	145·6	6·60	9·0	11·2	2	·774
663	+46, 2952		27·1	46	14	111·8	5·35	9·5	11·2	2	·916
664	+46, 2965		29·2	46	14	65·9	5·20	8·9	12·8	3	·894
665	+46, 2973		30·4	46	57	124·6	5·45	8·9	9·2	2	·918
666			31·6	48	9	316·0	3·25	10·1	10·7	3	·776
667	+44, 3525		35·2	44	17	184·3	9·92	8·7	9·2	3	·640
	+44, 3552		39·8	44	34	297·4	40·83	8·5	8·7	3	·736
668	+44, 3555		40·0	44	39	72·7	6·17	8·4	14·0	3	·640 AB
						269·9	23·30	C=	12·7	3	·640 AC
	+44, 3569		41·5	44	26	79·4	53·74	8·5	8·7	2	·728
669	+46, 3054		44·8	46	31	70·2	4·58	9·2	10·4	3	·798
670	+45, 3294		46·0	45	51	81·9	6·50	9·1	9·2	2	·778
671	+46, 3069		46·7	46	13	92·6	1·82	9·2	10·0	4	·771
672	+47, 3195		46·9	47	11	162·5	4·05	9·2	9·3	2	·918
673			50·5	46	8	81·6	4·37	9·5	9·7	2	·848
674	+44, 3636		52·3	44	25	91·5	5·05	9·4	12·0	2	·668
675	+44, 3637		52·8	44	24	107·2	3·70	9·6	11·0	2	·753 BC
						272·3	99·63	A=	9·5	3	·849 AB
676	+44, 3648		54·3	45	7	284·8	6·40	9·0	11·7	4	·920
677	+44, 3650		54·4	45	9	162·8	5·97	9·1	12·2	2	·916
678	+47, 3379	21	17·7	47	38	116·4	4·10	9·5	11·5	2	·916
679	+47, 3400		22·0	47	15	275·6	4·52	9·4	10·6	3	·749
680	+47, 3415		24·2	47	23	332·5	8·80	8·6	12·0	2	·798
681	+53, 2715		46·2	53	14	46·2	2·10	9·5	9·6	3	·923
682	+47, 3624		53·7	47	47	134·7	7·40	9·1	11·7	3	·748
683	+43, 4098		54·6	44	13	248·7	8·85	8·4	8·9	2	·705
684	+53, 2753		55·5	54	3	273·0	4·30	9·2	12·5	2	·943

1909MNRAS..69..223E

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	°	h	m	°	′	°	″				1908.
	+47, 3694	22	2·8	47	22	278·7	38·43	8·3	8·7	2	·754
685	+48, 3621		4·4	48	43	56·7	6·04	8·5	10·3	3	·912
686	+47, 3717		6·4	47	29	159·7	7·17	10·0	10·1	3	·771 BC
						90·7	9·42	A=	8·9	3	·771 AB
						119·3	14·24			2	·777 AC
	+47, 3720		6·6	47	25	307·6	22·10	7·0	9·3	3	·767
687	+47, 3792		21·5	47	37	269·6	4·92	9·0	9·1	2	·746
688	+46, 3726		26·8	46	30	20·1	2·02	9·3	9·5	3	·846
689	+54, 2800		29·3	54	15	286·6	10·33	8·6	14·0	3	·814
690	+47, 3856		32·5	47	22	258·1	11·36	8·0	11·4	3	·763
691	*h* 1830		50·1	55	7	278·3	5·85	9·5	12·5	2	·705 AB
						80·3	14·27	C=	9·6	2	·705 AC
						276·2	20·80	D=	13·5	1	·671 AD
692	+54, 2894		56·2	54	16	159·4	4·00	10·0	10·5	3	·914 BC
						252·8	94·00	A=	8·7	3	·914 AB
	+54, 2899		57·8	54	22	252·6	30·83	8·8	9·0	2	·916
693	+47, 4023		58·2	47	34	37·5	5·45	9·3	11·5	2	·746
694	+47, 4090	23	11·5	47	28	92·3	3·52	9·5	12·0	2	·750
695	+53, 3127		14·0	53	37	312·7	5·12	8·6	9·0	3	·864 AB
						303·9	25·88	C=	12·2	3	·864 AC
696	+53, 3133		14·6	53	36	230·9	2·92	8·9	11·5	3	·864
697	+54, 2954		15·9	54	57	74·9	3·87	9·0	12·5	2	·932 BC
						344·1	68·26	A=	8·5	2	·941 AB
698	+47, 4130		16·8	47	23	57·5	3·20	8·8	12·0	2	·754
699	+47, 4238		35·8	47	17	220·4	6·88	8·7	10·2	3	·843
700	+53, 3238		45·7	53	38	34·9	14·64	6·5	10·5	2	·906
701	+54, 3075		51·3	55	3	309·3	3·83	9·4	10·7	3	·930
702	+53, 3263		53·1	53	44	106·9	4·27	8·9	13·3	3	·869
	+53, 3266		54·2	53	19	105·6	16·99	8·2	9·0	2	·855
703	+53, 3268		54·5	53	26	269·1	7·05	8·1	11·7	3	·768 AB
						267·2	53·03	C=	9·5	1	·671 AC
704			55·0	53	27	119·4	5·45	9·5	11·5	2	·709

Notes.

624.—*h's* angle for AC is 148°·4; if this is correct the close pair may have considerable proper motion.

630.—Angles discordant, difficult in twilight.

648.—Discordant measures.

657.—The p. star of two.

671.—In low-powered field S of β 250.

+47°, 3720 A 12 mag. sp. from B.

691.—The nearer *comes*, and the distant one not given by *h*.

697.—On two nights A was suspected to be a close double.

1909MNRAS..69..223E

A new Dividing Engine. By G. T. McCaw, M.A.

(Plate 13.)

About four years ago a dividing engine was constructed in South London by Messrs. E. R. Watts & Son. The constructors recently submitted a 55 cm. circle divided on this machine to the Charlottenburg Technical Institute. The result of this test may not be without interest to many members of the Society.

A few details of the machine may be given.

The main frame is of cast iron, while the revolving table is of phosphor bronze; the central spindle is of phosphor bronze, fitted in collars of oil-hardened steel. The fitting of the latter was done at the Whitworth Works, and the resultant eccentricity was subsequently found to be exceedingly small; all the rest of the machine was constructed by the owners themselves. The revolving table weighs about five cwt., and the whole engine two tons.

After the revolving table was in position, three silver rings were inlaid on the circumference of the upper face. The circle was first hand-divided, and then this graduation was tested with seven micrometers. The resultant errors were used for recutting the *traits*, and these were again tested for error. This adjusting process was continuously repeated for five months, until the micrometers indicated that none of the 4320 *traits* exhibited a greater error that 0″·6.

This graduation was now utilised for cutting the peripheral teeth of the revolving table, which engage the endless screw of the rotating gear. Every tooth was cut only after the V-cutter had been adjusted from the mean reading of the seven micrometers. Under all circumstances the temperature is kept as constant as possible, the engine being placed in a specially constructed room.

The engine is operated from a public electrical supply, and in cutting ordinary small circles for theodolites the working is entirely automatic. For the division of finer circles, the work is carried on during those periods of the day when the voltage is nearly constant, as changes of potential would slightly affect the accuracy of the graduation.

The engine will divide circles of from 3 in. to 4 ft. 6 in. diameter. The range of graduation extends from less than 1 minute up to 30 minutes of arc. Unlike some other constructors, this firm believes in dividing continuously; they are of opinion that the other system would involve more risk of error, due to local changes of temperature in the graduating-room.

The dividing can be controlled cut by cut, so that if slight inaccuracies in the peripheral teeth or endless screw or other part of the machine are proved productive of regular errors at certain parts of the circle, these errors may be mechanically eliminated.

The results of the examination at Charlottenburg are given in the table below. In this table the figures are so arranged that the sum of the errors of the thirty divisional lines, the numbers of which are successive multiples of 12, is zero. These thirty lines